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# The Inefficiency of the Operative Surgical Methods in use for Permanent Sterilisation of the Female.

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INDICATIONS of anything approaching general acceptance for deliberate contraceptive sterilization in the female must be very few nowadays. I know of no one indication which is agreed by all obstetricians to be indisputable. Contracted pelvis as an indication is on the brink of final exclusion, and the more debatable indications of pregnancy in association with phthisis, chronic nephritis and osteomalacia have all more recently been subject to rather successful attack.

I take it as a truism that the considerations which would impel any operator to attempt preventive sterilization must be of the most emphatic nature. Ethically, the indication should be absolute and indisputable.

If the indication must be absolute, it surely follows logically that the operative procedures employed to achieve sterility should be absolutely reliable for the purpose. An uncertain result on an absolute indication is worse than useless.

That there is an absolutely certain operative method is, however, open to grave doubt. A careful search through the literature on the subject in the past 15 years shows the untenability of even the most radical methods in vogue, to the title of absolute reliability. Routh,<sup>1</sup> in his epoch-making study of Cæsarean section, gave a list of eight methods in use up to 1911. He stated that the removal of the Fallopian tubes, in whole or in part, was the method most in favour. It is an interesting fact that not one of the methods he mentioned has stood the tests of time and experience, and that the most unsatisfactory type of operation is the one which he stated then to be the most popular.

I was induced to investigate this subject by the failure of occlusion of the oviducts to prevent further pregnancy on two occasions in my own practice. In the first case, full-time pregnancy occurred after an operation involving simple ligature of the tubes and ventro-fixation for procidentia in 1909. The second was a case of repeated intrauterine pregnancy after cornual excision of the Fallopian tubes for bilateral pyosalpinx. Though not unique, the latter case is of sufficient interest to appear worthy of fuller report. The history of the case is therefore as follows :—

Mrs. F., aged 24; married 12 months. Never pregnant. Complaining of increasing menorrhagia and dysmenorrhœa.

Examination on Nov. 3rd, 1915, showed uterus slightly enlarged and held in partial retroversion by adhesions. Both tubes thickened and tender to palpation. Appearances at vulva suggested chronic gonococcal infection though there was no acute history of gonorrhœa.

At the operation on Nov. 4th, 1915, the uterus was found to be held back by recent adhesions of both tubes to the floor of Douglas's pouch in the sub-ovarian fossæ. Both tubes were thickened to the diameter of a little finger and somewhat tortuous. There were no other adhesions. I excised both Fallopian tubes by cutting the interstitial portions widely out of the cornua uteri, and suturing the resultant cornual wounds deeply and thoroughly, with careful approximation of the peritoneal and muscular tissues. An apparently healthy appendix was amputated and the uterus ventro-suspended. Recovery was uninterrupted.

Re-examination on July 5th, 1917, showed the uterus loosely attached to the abdominal wall; slightly metritic; no trace of pelvic inflammation. Patient reported herself as "feeling splendid."

On February 15th, 1918, her doctor reported that she had had a miscarriage after an air raid. He judged the foctus (a male) to be about  $4\frac{1}{2}$  to 5 months of age. Another early abortion occurred about May 1919.

The operative methods in vogue to the present time to achieve permanent sterilization have been of every conceivable type. The following is a complete list compiled from all the literature I have been able to investigate on the subject in the past 15 years. Any reported cases in which the history of the case or the technique of operation are doubtful have been excluded.

The methods may be divided, for purposes of classification, into four anatomical types :---

- (1) Ovarian.
- (2) Tubal.
- (3) Uterine.
- (4) Ovarian, Tubal and Uterine.

The particular types under each heading are as follows :---

- I.—OVARIAN. Ablation of ovarian function has been attempted by :—
  - (1) X-rays.
  - (2) Surgical ablation of ovaries.
  - (3) Burying of ovaries under peritoneum or in closed peritoneal pockets.

2.-TUBAL (bilateral) ablation by :---

- (1) Simple ligature.
- (2) Tubal crushing-more or less extensive.
- (3) Crushing with subsequent ligature.
- (4) Double ligature of tubes and division between.
- (5) Double ligature of tubes and division between with burying of the proximal tubal stump under peritoneum.
- (6) Excision of a portion of tube between ligatures.
- (7) Excision of whole tube (leaving a stump only).
- (8) Excision of whole tube and uterine cornu with suture.
- (9) Burial of uterine fundus extraperitoneally after ablation of whole or parts of tubes.
  - (a) Between bladder and vagina (as in Watkins-Mackenrodt operation).
  - (b) In abdominal wall (as in Kocher's operation for prolapse).
- (10) Burial of fimbriated end of tube under peritoneum.
  - (a) In broad ligaments.
  - (b) In inguinal canals.
- (11) Invagination of fimbriated ends of tubes.
- (12) Tubal cauterisation by chemicals or heat.

3.—UTERINE ablation by :—

- (1) Atmocausis (hot vapour injection).
- (2) Radium (intra-uterine).
- (3) Hysterectomy alone (total or sub-total).
- (4) Hysterectomy with tubal ablation.

4.-ABLATION of uterus, tubes and ovaries.

A consideration of this catalogue seriatim is of interest from the point of view of the relative efficiency of the various methods.

I.—OVARIAN METHODS.

The first two ovarian methods (bilateral oöphorectomy and X-ray irradiation) call for brief consideration. The possible unhappy after effects of these operations, even if successful, are

sufficient of themselves to make them unpopular methods. But apart from this, experience has abundantly proved them to be unreliable. The difficulty of certainly removing all ovarian tissue by local operation is well known. Well authenticated instances of pregnancy, after apparently complete bilateral ovariotomy. have occurred in the practice of such reliable operators as Doran<sup>2</sup> and Meredith,<sup>3</sup> and later of Heogh.<sup>4</sup> Sutton<sup>5</sup> and Doran<sup>6</sup> also report its occurrence after bilateral oöphorectomy. Isolated areas of functioning ovarian tissue, frequently situated far from the normal ovarian sites, and often detectable only by microscopic examination, are more frequent than was at one time believed. Beigel7 collected 23 cases of supernumerary ovaries, Von Winckel<sup>8</sup> 18, and Seitz<sup>9</sup> 5, previous to 1909. Authentic cases have also been reported by Frankl,<sup>10</sup> Reis,<sup>11</sup> Sippel,<sup>12</sup> and Franks.<sup>13</sup> Doran<sup>14</sup> discusses the occurrence of accessory ovaries in his "Harveian Lectures on Fibroids." Mériel<sup>15</sup> says they are present in 4 per cent. of all females.

These facts indicate definitely that sterilization by ovarian excision cannot be depended upon. The same may be said of X-ray sterilization. I have known cases of apparent failure to sterilize (at least in a given number of irradiations) even with recent apparatus; and the experiments of Claud Regaud<sup>17</sup> in guinea pigs, cats and bitches show that absolute reliance cannot, so far at any rate, be placed on this method.

The third ovarian method (burying ovaries in closed peritoneal pouches) is recommended by Blumberg.<sup>19</sup> The operation has not often been done. Jacques,<sup>20</sup> however, reported a case last year in which it had been done in combination with hysterectomy, and in which pregnancy occurred four years later. I shall refer to this case later.

This method is open to even greater criticism than opphorectomy in the matter of unreliability, for, in addition to the possibility of the presence of accessory ovarian tissue in any individual, there is the known tendency to slow resolution of aseptically produced peritoneal adhesions and the consequent opening up of artificial peritoneal pouches.

### 2.—TUBAL METHODS.

The multitude and diversity of tubal methods is a fair indication of the unreliability of any one of them.

First tubal method—simple ligature alone—is a long discredited method, but is still used at times as a temporary expedient. Cases of pregnancy after ligature alone are reported, during the period surveyed, by Jung,<sup>21</sup> Griffith,<sup>22</sup> Planchu,<sup>23</sup> Leonard<sup>24</sup> (2 cases), and McArthur.<sup>25</sup> Christopher Martin<sup>26</sup> has also had a case of this type. In two at least of these no trace of tube constriction or ligature was observable at later operations. In Planchu's case both tubes were found completely divided at the site of ligature at a later operation. The divided ends of the proximal portions of the tubes appeared to be closed, but pregnancy occurred two months later. Munro Kerr<sup>27</sup> found the divided tubal ends patent at a later operation on two occasions after previous ligature. Offergeld<sup>28</sup> found the same thing in experimental tubal ligature in bitches. A number of other cases have been reported at different times.

The second tubal method —ligature after crushing the tubes and the third—tubal crushing alone—were also shown by Offergeld<sup>29</sup> to fail at times. Casalis<sup>30</sup> gives a full report of a failure after crushing and ligature in a patient of his own.

Fourth tubal method—Simple division of the tubes between ligatures—though still popular, was shown to be unreliable by Fränkel<sup>31</sup> in animals, and Zweifel<sup>32</sup> in woman. Purslow<sup>33</sup> had a case of normal pregnancy after this operation had been done, and Munro Kerr<sup>34</sup> mentions other recorded cases. In any case the anatomical conditions resulting from this operation are exactly the same as occur in cases in which the tube has been divided in the process of removing a portion—and after this latter operation there are an unusual number of failures to record.

Fifth tubal method. It was thought that the further refinement of covering the proximal cut ends of the divided tubes under peritoneum would prove an absolute safeguard, but Crook<sup>35</sup> reports one case of full-time pregnancy after this method, in which there seems no reason to doubt the use of an accurate technique at operation; and there are others on record (cf. Leonard).<sup>24</sup> Eight cases reported by Hirst,<sup>36</sup> Polak<sup>37</sup> and Mainzer,<sup>38</sup> in which intrauterine pregnancies occurred after total tubal excision with peritoneal in-covering (in the process of extra-peritoneal burial of the fundus in the Watkins operation for prolapse) are analogous cases in this class, and show the futility of covering the tubal ends under peritoneum. These cases are quoted, however, in a later category.

Sixth and seventh tubal methods—Excision of a portion of the tubes between ligatures; and excision of all but the uterine stumps of the tubes.

The essential resulting condition in these operations is the same whether the divided distal portion of the tube be removed or not. The non-patency of the stump, or portion connected up with the uterus, is the only thing that counts from the point of view of preventive sterilization. If it can be shown that this uterine portion may become patent again after ligature, the fact invalidates all operations of this type, from simple division between ligatures to excision of the whole tube with ligature of the merest remaining stump. That this type of operation is extremely unreliable has, however, been shown in a number of instances.

Cases have been reported by Wood,<sup>39</sup> Clark and Norris,<sup>40</sup> Polak,<sup>41</sup> and Mainzer. It appears certain that Doran's, Stanbury Sutton's and Meredith's cases of pregnancy after bilateral ovariotomy (previously noted) must appear under this heading as well; and also two cases reported by Cripps and Williamson.42 Leonard mentions one case in his own hospital and notes that a number of others have been reported. In the case reported by Clark and Norris, a full-time normal intra-uterine pregnancy occurred after amputation of bi-lateral large pus tubes. One ovary was also removed. In Polak's cases both tubes were removed for tubal inflammation. An intra-uterine pregnancy with normal labour at term followed in one case, and in the other an interstitial pregnancy occurred on the right side. In Wood's case pregnancy occurred in the proximal tubal stump on the right side after bi-lateral double ligature, and excision of the intervening portion of the tube, during an operation for prolapse. In the case reported by Mainzer, pregnancy occurred after excision of the tubes and burial of the fundus extra-peritoncally.

In addition to the above cases, there are very numerous cases of pregnancy in the tubal stump left after unilateral salpingectomy. Cases of this type are reported by Lesse,<sup>43</sup> Hofmeier,<sup>44</sup> Morbit,<sup>45</sup> (after removal of a pus tube), Clifford,<sup>46</sup> Campbell,<sup>47</sup> Pearson,<sup>48</sup> and Clark and Norris.<sup>49</sup> In Lesse's and Hofmeier's cases the pregnancy was in the interstitial portion of the tube. Lesse's case went to the sixth month. In Pearson's case the cut ends of the tube were found united at subsequent operation for extra-uterine pregnancy in the same tube. It is unbelievable that the impregnated ovum in these cases had reached the tubal lumen by any other means than the re-opening of the ligatured end of the tubal stump.

The eighth tubal method.—Bi-lateral excision of the whole tube and uterine cornu, with suture of the cornual incision in single or double layer—has also been a popular method. But I have reported above a case in which it failed, and Coventry<sup>50</sup> and Beckwith Whitehouse<sup>51</sup> have had similar cases. Coventry's case went to labour at seven months, and Whitehouse's to full time. In Whitehouse's case both tubes were excised out of the cornua for hydrosalpinx.

Polak<sup>52</sup> reports an interstitial pregnancy after a radical (cornual) salpingectomy on the same side.

Hirst had three cases of intra-uterine pregnancy, and Polak four, after operations for prolapse, which involved not only

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bi-lateral cornual excision, but extra-peritoneal implantation of the fundus between the bladder and anterior vaginal wall.

Two of Polak's cases went to, or near, full time, and one other to six months. Hirst's three cases all ended in uterine abortion about the third month.

Polak advises, as an additional refinement to cornual excision, the crushing of the severed tubal ends, and the suturing of them to the posterior uterine wall. I cannot see the object of this operation, or how it will make the attainment of sterility any more certain.

It is illuminating to know that Fränkel, so long ago as 1905, stated that sterilizing operations of this tubal excision type were useless, as a utero-abdominal fistula could always develop.

The ninth tubal method—Burial of the uterine fundus extraperitoneally after ablation of both tubes in whole or in part.

(a) Burial between bladder and vagina (in Watkins-Mackenrodt operation for prolapse) has failed three times in Hirst's experience, four times in Polak's, and once in Mainzer's, as above quoted. In Hirst's cases the cornua were excised as well, while in Mainzer's the tubal stumps were left. In the latter case there is a slight doubt as to whether the pregnancy ante-dated the operation or not.

(b) Burial in the abdominal wall as in Kocher's operation. I can find no case of pregnancy after this operation in the literature investigated, but its essential similarity to the previous operation from the sterilizing point of view is obvious, and it is open to equal objection. The same may be said of Stettin's<sup>54</sup> operation, in which the unexcised tubes are buried with the fundus uteri.

The tenth tubal method - Embedding of the fimbriated ends of the tubes under peritoneum -- is probably the most popular method of all nowadays.

It is most commonly done by burying the fimbriated ends in pockets, or through incisions, on the anterior aspects of the broad ligaments, though Menge<sup>55</sup> advised secreting them in the inguinal canals. A failure of this operation, in its broad ligament form, is reported by Child.<sup>56</sup> His patient was first operated on in Nov. 1913, for prolapse, and was sterilized by embedding the fimbriated ends of the tubes in retro-peritoneal pockets cut in the anterior face of the broad ligaments. They were fixed in place by a continuous enclosing suture of fine silk.

The abdomen was opened  $3\frac{1}{2}$  years later on a diagnosis of left tubal pregnancy. The fundus was opened by transverse incision, and an apparent interrupted early pregnancy cleared out. No fœtus was found, but the pathological laboratory reported evidences of pregnancy. Examination at operation showed no sign of communication between the peritoneal cavity and the embedded right tubal ostium, but in one place there was a pin point communication on the left side. There seems no reason to doubt the thoroughness and carefulness of Child's technique at either operation.

Culbertson<sup>53</sup> describes a more complicated operation with the similar aim of excluding the fimbriated ends of the Fallopian tubes in an artificial peritoneal sac. He has performed it 31 times without a recurrence of pregnancy. He quotes an extensive literature on the subject.

As regards Menge's method I know of no case of failure, but I cannot think it gives hope of greater certainty of sterilization than even more complete operations, such as the Watkins-Wertheim-Mackenrodt method; and yet this latter has failed on several occasions, as we have seen.

*Eleventh Tubal Method.* Child thinks a surer way would be to invert the fimbriæ into the tube, and then close the lumen with a purse-string suture. A recollection of the failure of tubal occlusion by suture, ligature, etc., leads one to the conclusion that his optimism is hardly justified.

It is remarkable that aseptic operative procedures to close the Fallopian tubes should so often fail to achieve permanent success, in the face of the known frequency of tubal infection as a cause of permanent closure and sterility. Incidentally the closure in infective cases, be it noted, is practically always at the fimbriated end. It seems an obvious inference that the presence (at least in the initial stages) of some degree of inflammation, beyond that which can be produced by aseptic, or antiseptic methods, is necessary to obtain permanent adhesions. Ligature, suture and excision (with the addition of sub-peritoneal burying), have all failed.

The presence of live organisms, probably of pus-forming type (B. coli, gonococci, strepto- and staphylococci) appears to be necessary, and it would seem that even tubes closed in this way may reopen when the organisms have died out (e.g., Lochrane, Norris, Morbit). Closure at the fimbriated end is most likely to effect sterility as it has been frequently shown that the tubal lumen at the uterine end is rarely, if ever, truly closed in tubal infections (Landau,<sup>57</sup> Reymond<sup>58</sup> Albers<sup>59</sup>).

Twelfth tubal method—Cauterisation by chemicals or heat.

Fränkel, in his experiments on animals, failed to close the ends of tubes divided by the cautery in their continuity. I have been unable to find any report of this method having been tried in the human subject. Dickenson<sup>60</sup> reports a method of electro-cauterisation of the intra-uterine tubal openings through the uterine cavity, but is not convincing as to its reliability. He gives no particulars of any cases. Considering the results of Fraenkel's cautery experiments on the abdominal portions of the tubes on the one

hand, and of intra-uterine atmocausis on the other, it appears more than possible that sterilization, if effected at all, will be at best temporary. The method is a dangerous one. Tubal sterilization by strong chemicals applied, via the uterus, was recommended by Froriep,<sup>61</sup> but has never been taken up. It is open to even greater objection than the cautery.

Lastly, Lecène <sup>62</sup> mentions that cases have been reported of pregnancy in an accessory Fallopian tube.

Having considered the uncertainty of tubal methods of sterilization, let us consider the third great class—the uterine methods.

3. UTERINE METHODS.

Uterine exclusion has been advocated by the operation of atmocausis (practically a cooking of the uterine mucosa by hot vapour injection) and by hysterectomy, with, or without, tubal ablation.

Atmocausis (first recommended by Pincus) has stood condemned for some years as being both uncertain and dangerous. Occurrences of pregnancy after apparently successful sterilization by this operation are reported by Meyer,<sup>63</sup> by Baumgart and Beneke,<sup>64</sup> and by Stolz.<sup>65</sup> In Baumgart and Beneke's case the operation was followed by four years of amenorrhœa, and then by pregnancy. Hysterectomy was necessary. Examination of the specimen after operation showed a total absence of decidua in the region of the placental site.

Claims have recently been made in favour of the intra-uterine use of *radium* and *radium emanation* as a sterilizing agent. Amenorrhœa is usual after the intra-uterine use of radium for intractable menorrhagia, etc. A long enough period has not elapsed to allow of a final opinion being formed as to the permanency of the effects of radium. Its action appears to be localized to the uterus, and in this respect it resembles atmocausis. Amenorrhœa alone cannot be accepted as a sign of sterility. It does not appear that the destruction of endometrium by the action of radium could be any more thorough than that caused by atmocausis in Baumgart's case, and yet subsequent pregnancy occurred in that instance. Theoretically, as the intra-uterine application of radium does not destroy function in the ovaries or tubes, it appears by no means impossible that impregnation may occur at some later period after its use.

Supra-vaginal hysterectomy alone is advised by Bland Sutton,<sup>5</sup> Jardine,<sup>68</sup> Munro Kerr,<sup>27</sup> and others, when absolute certainty is desired. Other operators go further and excise the tubes as well.

These may seem the methods of finality, but Taylor<sup>66</sup> states that tubal pregnancy has occurred on one or two occasions after vaginal hysterectomy. Even after supra-vaginal hysterectomy with bilateral salpingectomy, removal of one ovary, and the burying of the other under peritoneum, pregnancy has occurred in at least one case. This case is reported by Jacques.<sup>20</sup> The patient showed signs of pregnancy four years after Jacques had performed the above operations. A fœtus 9 cm. long was extracted by posterior colpotomy.

There seems no reason to doubt the facts of Jacques' report, and, in face of what is known of the vagaries of the peritoneum, the occurrence is not at all improbable.

As a corollary it appears that a *total ablation of uterus and pelvic adnexa* might occasionally fail to prevent subsequent pregnancy in the presence of accessory extra-pelvic ovarian tissue.

### GENERAL CONCLUSIONS.

1. There is no absolutely reliable method of achieving sterility by surgical means. Pregnancy has occurred under such anomalous circumstances as to suggest that there is a definite *positive* chemiotaxis between ovum and spermatozoon. Whatever views medical science may from time to time hold on the question of the place of sterilization operations in surgery, Nature hardly appears to approve of them.

2. No reliance can be placed on methods involving ablation of ovaries or Fallopian tubes.

3. No reliance can be placed on any method which involves seclusion of structures (ovarian or tubal) by covering them under peritoneum. The conclusion is forced upon one that peritoneal adhesions, produced by any method not involving organismal infection, will resolve in time (probably within 3-4 years); and conversely that the most effective means of producing sterility is by infection.

4. There is a definite tendency towards restoration of the tubal lumen, in the absence of infection, no matter what means have been used to occlude it. This tendency is greater the nearer the lesion is to the uterine end of the tube, and is most marked at the tubouterine ostium—where a fistula is liable to form even when the excised tube has contained pus.

There is abundant literature in support of the view that the lumen of the cornual portion of the tube is not obliterated as a rule in cases of hydro- and pyosalpinx. The usual cause of the obstruction to the outflow at the cornual end in these cases is kinking of the tubal mucous membrane only (Landau,<sup>57</sup> Albers,<sup>59</sup> Reymond<sup>58</sup>). There is a definite liability to extra-uterine gestation in the stumps

of tubes proximal to the site of division after non-radical salpingectomies. A similar tendency has been noted by Giles,<sup>67</sup> and Polak, after conservative salpingostomy. This liability for conception to take place immediately proximal to the lesion in the tube, suggests :

- (a) That the ovum has reached the tubal lumen through the opening-up of the cut end, rather than by traversing the other tube, uterine cavity, and tubal stump (reversely).
- (b) That in performing salpingectomy it is best always to excise the tube out of the uterine cornu, so that should a fistula form, and pregnancy occur, it may do so in the uterus, and not in the tubal stump.

There is some reason for the suggestion that excision of the tubes out of the cornua, far from being a good method of securing sterility, is possibly the most hopeful and safest form of conservative operation; and that it is of wider application than the usual conservative salpingostomy, as it allows of restoration of permeability even in the presence of large pus tubes. (There would appear to be a greater tendency to abortion when pregnancy occurs after this operation than in pregnancy under normal conditions. This may, however, possibly be due to associated inflammatory conditions in the uterus, and not to the operation itself.)

5. If an attempt is to be made to sterilize by tubal operation, interference would appear to be most hopeful at the fimbriated ends of the tubes. This is nature's site of closure in inflammatory conditions, and pregnancy has occurred in previously sterile cases after removal of the closed fimbriated end and larger portion of the tube in cases of pyosalpinx.

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